High Performance scientific computing
Assignment 4- Profiling

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1 Introduction

This report consist the report of all assgnmnet2 and assignment3. This miss rate was about 8% for D1. Rest were negligible. Most of the time went for MatrixMultiplcation as it should be. For Mpi some time went of Trasfer of data. For Nvidia most time went in tranfer for samaller problem. But it would reduce as the problem size increases.

2 Computer Spec

- Name: Lenovo Ideapad
- Processor: Intel i3 processor 3rd gen 2.4Ghz
- Ram memory: 4gb
- OS: Ubuntu 16.04
- Cache: 4mb

3 Result

3.1 Noraml

3.1.1 Cache Miss

```
==12400== I   refs:      4,176,693,109
==12400== I1  misses:            2,094
==12400== LLi misses:            1,894
==12400== I1  miss rate:          0.00%
==12400== LLi miss rate:          0.00%
==12400==
```

```
==12400== D   refs:      2,020,686,000  (1,884,982,093 rd   + 135,703,907 wr)
==12400== D1  misses:      157,131,716  (  156,797,236 rd   +     334,480 wr)
==12400== LLd misses:          154,269  (       39,487 rd   +     114,782 wr)
==12400== D1  miss rate:           7.8% (          8.3%     +         0.2%  )
==12400== LLd miss rate:           0.0% (          0.0%     +         0.1%  )
==12400==
==12400== LL refs:         157,133,810  (  156,799,330 rd   +     334,480 wr)
==12400== LL misses:           156,163  (       41,381 rd   +     114,782 wr)
==12400== LL miss rate:            0.0% (          0.0%     +         0.1%  )
```

3.1.2 Profile

```
Each sample counts as 0.01 seconds.
  %   cumulative   self              self     total
 time   seconds   seconds    calls   s/call   s/call  name
 99.77      7.31     7.31        4     1.83     1.83  matrixMultiplication(double**, double*
  0.27      7.33     0.02        4     0.01     0.01  getmatB(int)
  0.00      7.33     0.00       12     0.00     0.00  allocate(int)
  0.00      7.33     0.00        4     0.00     0.00  getmatA(int)
  0.00      7.33     0.00        1     0.00     0.00  _GLOBAL__sub_I__Z8allocatei
  0.00      7.33     0.00        1     0.00     0.00  _GLOBAL__sub_I_main
  0.00      7.33     0.00        1     0.00     0.00  __static_initialization_and_destructio
  0.00      7.33     0.00        1     0.00     0.00  __static_initialization_and_destructio
```

3.1.3 Call Trace

```
[1]     100.0    0.00    7.33                 main [1]
                 7.31    0.00       4/4           matrixMultiplication(double**, double**, in
                 0.02    0.00       4/4           getmatB(int) [3]
                 0.00    0.00       4/4           getmatA(int) [35]
-----------------------------------------------
                 7.31    0.00       4/4           main [1]
[2]      99.7    7.31    0.00       4         matrixMultiplication(double**, double**, int, i
                 0.00    0.00       4/12          allocate(int) [34]
-----------------------------------------------
                 0.02    0.00       4/4           main [1]
[3]       0.3    0.02    0.00       4         getmatB(int) [3]
                 0.00    0.00       4/12          allocate(int) [34]
-----------------------------------------------
                 0.00    0.00       4/12          matrixMultiplication(double**, double**, in
                 0.00    0.00       4/12          getmatA(int) [35]
                 0.00    0.00       4/12          getmatB(int) [3]
[34]      0.0    0.00    0.00      12         allocate(int) [34]
-----------------------------------------------
```

```
                0.00    0.00       4/4           main [1]
[35]     0.0    0.00    0.00       4         getmatA(int) [35]
                0.00    0.00       4/12          allocate(int) [34]
-----------------------------------------------
                0.00    0.00       1/1           __libc_csu_init [72]
[36]     0.0    0.00    0.00       1         _GLOBAL__sub_I__Z8allocatei [36]
                0.00    0.00       1/1           __static_initialization_and_destruction_0(i
-----------------------------------------------
                0.00    0.00       1/1           __libc_csu_init [72]
[37]     0.0    0.00    0.00       1         _GLOBAL__sub_I_main [37]
                0.00    0.00       1/1           __static_initialization_and_destruction_0(i
-----------------------------------------------
                0.00    0.00       1/1           _GLOBAL__sub_I_main [37]
[38]     0.0    0.00    0.00       1         __static_initialization_and_destruction_0(int,
-----------------------------------------------
                0.00    0.00       1/1           _GLOBAL__sub_I__Z8allocatei [36]
[39]     0.0    0.00    0.00       1         __static_initialization_and_destruction_0(int,
-----------------------------------------------
```

3.2 OPENMP

3.2.1 Cache Miss

```
==12098== I   refs:      4,580,649,125
==12098== I1  misses:            2,906
==12098== LLi misses:            2,412
==12098== I1  miss rate:          0.00%
==12098== LLi miss rate:          0.00%
==12098==
==12098== D   refs:      2,423,770,656  (2,288,051,762 rd   + 135,718,894 wr)
==12098== D1  misses:      157,130,102  (  156,795,102 rd   +     335,000 wr)
==12098== LLd misses:          155,151  (       39,934 rd   +     115,217 wr)
==12098== D1  miss rate:           6.5% (          6.9%     +         0.2%  )
==12098== LLd miss rate:           0.0% (          0.0%     +         0.1%  )
==12098==
==12098== LL refs:         157,133,008  (  156,798,008 rd   +     335,000 wr)
==12098== LL misses:           157,563  (       42,346 rd   +     115,217 wr)
==12098== LL miss rate:            0.0% (          0.0%     +         0.1%  )
```

3.2.2 Profile

```
 time   seconds   seconds    calls  ms/call  ms/call  name
 95.57     10.68    10.68                             execute_cfa_program
  4.38     11.17     0.49                             base_of_encoded_value
```

```
  0.09     11.18     0.01        5     2.00     2.00  read_encoded_value_with_base
  0.00     11.18     0.00       13     0.00     0.00  matrixMultiplication(double**, double*
  0.00     11.18     0.00        4     0.00     0.00  getmatB(int)
  0.00     11.18     0.00        4     0.00     0.00  printMat(double**, double)
```

3.2.3 Call Trace

```
index % time    self  children    called     name
                                                 <spontaneous>
[1]     95.5   10.68    0.00                 execute_cfa_program [1]
-----------------------------------------------
                                                 <spontaneous>
[2]      4.4    0.49    0.00                 base_of_encoded_value [2]
-----------------------------------------------
                                    1            read_encoded_value_with_base [3]
                0.00    0.00       1/5           etext [5]
                0.01    0.00       4/5           allocate(int) [4]
[3]      0.1    0.01    0.00       5+1       read_encoded_value_with_base [3]
                0.00    0.00       4/13          matrixMultiplication(double**, double**, in
                                    1            read_encoded_value_with_base [3]
-----------------------------------------------
                                                 <spontaneous>
[4]      0.1    0.00    0.01                 allocate(int) [4]
                0.01    0.00       4/5           read_encoded_value_with_base [3]
                0.00    0.00       4/4           getmatB(int) [34]
                0.00    0.00       4/4           printMat(double**, double) [35]
-----------------------------------------------
                                                 <spontaneous>
[5]      0.0    0.00    0.00                 etext [5]
                0.00    0.00       1/5           read_encoded_value_with_base [3]
                0.00    0.00       1/13          matrixMultiplication(double**, double**, in
-----------------------------------------------
                                    1            matrixMultiplication(double**, double**, in
                0.00    0.00       1/13          etext [5]
                0.00    0.00       4/13          printMat(double**, double) [35]
                0.00    0.00       4/13          __static_initialization_and_destruction_0(i
                0.00    0.00       4/13          read_encoded_value_with_base [3]
[33]     0.0    0.00    0.00      13+1       matrixMultiplication(double**, double**, int, i
                                    1            matrixMultiplication(double**, double**, in
-----------------------------------------------
                0.00    0.00       4/4           allocate(int) [4]
[34]     0.0    0.00    0.00       4         getmatB(int) [34]
-----------------------------------------------
                0.00    0.00       4/4           allocate(int) [4]
```

```
[35]     0.0    0.00    0.00       4         printMat(double**, double) [35]
                0.00    0.00       4/13          matrixMultiplication(double**, double**, in
```

3.3 MPI

3.3.1 Cache Miss

```
==12277== I   refs:      101,715,644
==12277== I1  misses:         90,342
==12277== LLi misses:         12,933
==12277== I1  miss rate:        0.09%
==12277== LLi miss rate:        0.01%
==12277==
==12277== D   refs:       31,781,643  (20,879,438 rd   + 10,902,205 wr)
==12277== D1  misses:        420,242  (   326,607 rd   +     93,635 wr)
==12277== LLd misses:        125,191  (    67,962 rd   +     57,229 wr)
==12277== D1  miss rate:         1.3% (       1.6%     +        0.9%  )
==12277== LLd miss rate:         0.4% (       0.3%     +        0.5%  )
==12277==
==12277== LL refs:           510,584  (   416,949 rd   +     93,635 wr)
==12277== LL misses:         138,124  (    80,895 rd   +     57,229 wr)
==12277== LL miss rate:          0.1% (       0.1%     +        0.5%  )
```

3.3.2 Profile

```
Each sample counts as 0.01 seconds.
  %   cumulative   self              self     total
 time   seconds   seconds    calls  ms/call  ms/call  name
 99.26      3.91     3.91        4   977.69   977.69  matrixMultiplication(double**, double*
  0.51      3.93     0.02        4     5.00     5.00  getmatB(int)
  0.25      3.94     0.01        4     2.50     2.50  getmatA(int)
  0.00      3.94     0.00       12     0.00     0.00  allocate(int)
  0.00      3.94     0.00        1     0.00     0.00  _GLOBAL__sub_I__Z8allocatei
  0.00      3.94     0.00        1     0.00     0.00  _GLOBAL__sub_I_main
  0.00      3.94     0.00        1     0.00     0.00  __static_initialization_and_destructio
  0.00      3.94     0.00        1     0.00     0.00  __static_initialization_and_destructio
```

3.3.3 Call Trace

```
index % time    self  children    called     name
                                               <spontaneous>
[1]    100.0    0.00    3.94                 main [1]
                3.91    0.00       4/4           matrixMultiplication(double**, double**, in
                0.02    0.00       4/4           getmatB(int) [3]
```

```
                0.01    0.00       4/4           getmatA(int) [4]
-----------------------------------------------
                3.91    0.00       4/4           main [1]
[2]     99.2    3.91    0.00       4         matrixMultiplication(double**, double**, int, i
                0.00    0.00       4/12          allocate(int) [35]
-----------------------------------------------
                0.02    0.00       4/4           main [1]
[3]      0.5    0.02    0.00       4         getmatB(int) [3]
                0.00    0.00       4/12          allocate(int) [35]
-----------------------------------------------
                0.01    0.00       4/4           main [1]
[4]      0.3    0.01    0.00       4         getmatA(int) [4]
                0.00    0.00       4/12          allocate(int) [35]
-----------------------------------------------
                0.00    0.00       4/12          matrixMultiplication(double**, double**, in
                0.00    0.00       4/12          getmatA(int) [4]
                0.00    0.00       4/12          getmatB(int) [3]
[35]     0.0    0.00    0.00      12         allocate(int) [35]
-----------------------------------------------
                0.00    0.00       1/1           __libc_csu_init [301]
[36]     0.0    0.00    0.00       1         _GLOBAL__sub_I__Z8allocatei [36]
                0.00    0.00       1/1           __static_initialization_and_destruction_0(i
-----------------------------------------------
                0.00    0.00       1/1           __libc_csu_init [301]
[37]     0.0    0.00    0.00       1         _GLOBAL__sub_I_main [37]
                0.00    0.00       1/1           __static_initialization_and_destruction_0(i
-----------------------------------------------
                0.00    0.00       1/1           _GLOBAL__sub_I_main [37]
[38]     0.0    0.00    0.00       1         __static_initialization_and_destruction_0(int,
-----------------------------------------------
                0.00    0.00       1/1           _GLOBAL__sub_I__Z8allocatei [36]
[39]     0.0    0.00    0.00       1         __static_initialization_and_destruction_0(int,
-----------------------------------------------
```

3.4 Nvidia

3.5 Profile

```
==9686== NVPROF is profiling process 9686, command: ./matMul
==9686== Profiling application: ./matMul
==9686== Profiling result:
Time(%)      Time     Calls       Avg       Min       Max  Name
 99.50%  2.04847s      1800  1.1380ms  101.58us  1.6545ms  matrixMultiplication(double*, dou
  0.26%  5.3633ms      1808  2.9660us     736ns  2.1503ms  [CUDA memcpy HtoD]
  0.24%  4.9419ms      1800  2.7450us  1.8560us  3.8400us  [CUDA memcpy DtoH]
```

```
==9686== API calls:
Time(%)      Time     Calls       Avg       Min       Max  Name
 95.71%  2.09160s      3608  579.71us  5.9730us  2.2995ms  cudaMemcpy
  3.38%  73.804ms        16  4.6128ms  9.0570us  72.492ms  cudaMalloc
  0.73%  15.920ms      1800  8.8440us  7.9000us  33.829us  cudaLaunch
  0.07%  1.5746ms      7200     218ns     179ns  3.9520us  cudaSetupArgument
  0.05%  1.0184ms      1800     565ns     347ns  299.50us  cudaConfigureCall
  0.04%  881.32us        16  55.082us  10.497us  110.55us  cudaFree
  0.02%  368.89us        83  4.4440us     261ns  150.48us  cuDeviceGetAttribute
  0.00%  48.410us         1  48.410us  48.410us  48.410us  cuDeviceGetName
  0.00%  43.185us         1  43.185us  43.185us  43.185us  cuDeviceTotalMem
  0.00%  2.7210us         2  1.3600us     617ns  2.1040us  cuDeviceGetCount
  0.00%     947ns         2     473ns     358ns     589ns  cuDeviceGet
```